

4-5-69



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## Genetics Can Be as Exciting as Astrology If You Ignore Subtleties of How Genes Act

THE ROLE of genetic factors in development and in disease is an exciting and productive area of modern biomedical research. It has also become an issue of great popular interest, and only in part because of its bearing on race problems. It may be odd for a scientist to show anything but great enthusiasm for that kind of public interest. I am sometimes alarmed, however, that it may be based on a fundamental misunderstanding that might be called "genetic fatalism."

Astrology is probably even more popular these days than genetics. This suggests how fascinated many people are by the idea of a predetermined fate. It may be just as scientific to look for this in the stars as in the genes if one ignores the subtleties of how genes act. But many popular discussions of genetics do precisely that, and can lead to such doubly absurd propositions as, "If genetic factors are involved in educational deficiencies, the Head Start program is a waste of effort."

Not only is the premise quite unproven, and in its present-day context very difficult to subject to any rigorous scientific test as a general issue. The conclusion does not follow either. Head Start will be a waste of effort only insofar as it is not directed to the actual problems of failure-prone children.

GENETICS, and biomedical analysis generally, probably can play a larger role than they have in trying to elucidate specific problems and specific remedies for them. It is often the case

that a genetic "defect" actually stems from a specific interaction with some environmental factor which is ignored by the majority.

This point has been beautifully illustrated by reports on a mutant gene in mice, called "pallid," in *Nutrition Reviews* magazine by Dr. Lucille S. Hurley of the University of California (Davis). The name "pallid" refers to the fact that the mutant mice have a washed-out discoloration in their fur, and albino eyes. They also suffer from an inability to balance themselves because of a defect in the development of minute bony structures, the otoliths, in the inner ear.

Under standard conditions, the pallid gene is inherited according to the now classical rules of Mendelian genetics. It is, then, far better understood than anything we can say, for example, about racial-genetic differences in intelligence in man.

Otolith defects very similar to those of the pallid mutation have also been found in the offspring of normal mice fed diets deficient in manganese during pregnancy. This metal is required in trace amounts for normal growth by many animals, and presumably by man, but very little is known of its function in the body.

THESE FINDINGS suggested a relationship between the pallid gene and manganese metabolism. And indeed, when extra manganese (to a level of one part per 1000) was added to the diet during pregnancy, genetically pallid offspring showed normal otolith de-

velopment and balancing function.

The pallid gene itself was not altered, only its effect on development of the mouse given the extra manganese before birth. The results could be explained by supposing that the pallid gene interferes with the normal utilization of manganese. The primary defect might be in the chemistry of the pigment (known to bind metals), or in kidney function or elsewhere.

The pallid-manganese relationship may have other

implications besides being an especially clear illustration of the interaction of genetics and environment. A rare genetic disease in man, ocular albinism, is clinically very similar to the pallid mutation in the mouse, and might eventually be found to respond to manganese. Furthermore, nutritional requirements for manganese may vary depending on pigmentation (that is, race) in man, but too little is known altogether about manganese in nutrition.

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